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Flowers and insects. XI.

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STELLARIA MEDIA Sm.¹—"Nat. from Eu."—The plant was observed in bloom from March 14th to Oct. 25th. It is not abundantly visited except in early spring, when the flowers form quite conspicuous patches. At this time frequent cross-pollination is inevitable. On seven days, March 25th to April 29th, and Oct. 15th, I observed the following visitors, all sucking:—

Hymenoptera—*Apidæ*: (1) *Apis mellifica* L. ♂; (2) *Ceratina dupla* Say ♂; (3) *Osmia lignaria* Say ♂; (4) *Nomada bisignata* Say ♂; (5) *N. luteola* Lep. ♂; *Andrenidæ*: (6) *Panurgus? andrenoides* Cr. ♂; (7) *Andrena sayi* Rob. ♂; (8) *A. illinoensis* Rob. ♀; (9) *A. flavo-clypeata* Sm. ♂; (10) *A. cressonii* Rob. ♂♀; (11) *A. forbesii* Rob. ♀; (12) *Augochlora pura* Say ♀, ab.; (13) *Halictus lerouxii* Lep. ♀; (14) *H. ligatus* Say ♀; (15) *H. fasciatus* Nyl. ♀; (16) *H. pilosus* Sm. ♀; (17) *H. gracilis* Rob. ♀; (18) *H. confusus* Sm. ♂♀; (19) *H. stultus* Cr. ♀; (20) *Colletes inaequalis* Say ♂; *Chalcididæ*: (21) *Smicra torvina* Cr.; *Ichneumonidæ*: (22) *Pimpla novita* Cr. (determined by Ashmead); *Tenthredinidæ*: (23) *Dolerus arvensis* Say.

Diptera—*Mycetophilidæ*: (24) *Sciara* sp.; *Syrphidæ*: (25) *Chilosia capillata* Lw.; (26) *Melanostoma obscurum* Say; (27) *Platychirus quadratus* Say; (28) *Syrphus ribesii* L.; (29) *S. americanus* Wd.; (30) *Mesograpta marginata* Say; (31) *Eristalis tenax* L.; (32) *E. aeneus* F.; (33) *E. dimidiatus* Wd.; (34) *Brachypalpus frontosus* Lw.; (35) *Syritta pipiens* L.; *Tachinidæ*: (36) *Gonia frontosa* Say, ab.; (37) *G. exul* Will.; *Sarcophagidæ*: (38) *Cynomyia* sp.; *Muscidæ*: (39)

¹See Axell: Om anordningarna för de Phanerogama Växternas Befruktning; Lubbock: British Wild Flowers in Relation to Insects; Müller: Fertilization of Flowers, and Weit. Beobachtungen; Henslow: Self-fertilization of Plants; Anna Bateson: The Effects of Cross-fertilization on Inconspicuous Flowers, Annals of Botany, I; Meehan: Contributions to the Life Histories of Plants, III, Proc. Acad. Sci. Phila., 1888; Battandier: Sur quelques cas d'heteromorphisme, Bull. Soc. bot. France, xxx; Ludwig: Botan. Ver. d. Provinz Brandenburg, xxvi; MacLeod: Untersuchungen über die Befruchtung einiger phanerogamen Pflanzen d. Belgischen Flora, Bot. Centralblatt, xxiii; Schulz: Beiträge zur Kenntniss d. Bestäubungseinrichtungen u. Geschlechtsvertheilung bei den Pflanz-en.

Pollenia rudis F.; (40) *Musca domestica* L.; (41, 42) *Lucilia* spp.; (43) *L. cornicina* F.; (44) *Myospila mediatubunda* F.; *Anthomyidæ*: (45) *Chortophila* sp.; *Cordyluridæ*: (46) *Scatophaga squalida* Mg.

Lepidoptera—*Nymphalidæ*: (47) *Pyrameis huntera* F.; *Lycaenidæ*: (48) *Lycaena pseudargiolus* B.-L.

Hemiptera—*Lygaeidæ*: (49) *Lygaeus turcicus* F.

	Bees.	Other Hymenoptera	Diptera	Other insects.	Total.
In Low Germany—Müller....	15	1	8	1	25
In Illinois.....	20	3	23	3	49

MALVA ROTUNDIFOLIA L.²—"Nat. from Eu."—In the Fertilization of Flowers Müller says that the flowers of this species attract few insects, and he gives a list of visitors which compares very unfavorably with the list taken on flowers of *M. sylvestris*. In Illinois the plant seems to have little difficulty in acquiring a useful set of visitors. The subjoined list compares favorably with Müller's list of visitors of *M. sylvestris*. The plant blooms from April to November. On eleven days, between May 14th and October 9th, the following insects were observed visiting the flowers:—

Hymenoptera—*Apidae*: (1) *Apis mellifica* L. ♀, s., freq.; (2) *Bombus pennsylvanicus* DeG. ♀, s.; (3) *Melissodes bimaculata* Lep. ♂, s.; (4) *Ceratina dupla* Say ♀, s. and c. p.; (5) *Nomada incerta* Cr. ♀, s.; (6) *Calliopsis andreniformis* Sm. ♂♀, s. and c. p., ab.; *Andrenidæ*: (7) *Agapostemon bicolor* Rob. ♂♀, s. and c. p.; (8) *A. radiatus* Say ♂, s., freq.; (9) *Augochlora pura* Say ♂♀, s.; (10) *Halictus pectoralis* Sm. ♂♀, s.; (11) *H. similis* Sm ♀, s. and c. p.; (12) *H. coriaceus* Sm. ♀, s.; (13) *H. ligatus* Say ♂♀, s.; (14) *H. fasciatus* Nyl. ♀, c. p., freq.; (15) *H. pilosus* Sm. ♀, s.; (16) *H. zephyrus* Sm. ♂, s., (17) *H. confusus* Sm. ♂♀, s., ab.; (18) *H. illinoensis* Rob. ♀, s.; (19) *H. stultus* Cr. ♂, s.; (20) *Prosopis affinis* Sm. ♀, f. p.

²See Sprengel: Das entdeckte Geheimniss; Lubbock: British Wild Flowers in relation to Insects; Henslow: On the Self-fertilization of Plants—Trans. Linn. Soc. II. 1; On the fertilization of flowers by bees and other insects—Journ. Roy. Hort. Soc. London, vi; Müller: Fertilization of Flowers, and Weit. Beobachtungen; MacLeod: Pyreneeënbloemen en hare bevruchting door insecten; Keller: Proc. Acad. Nat. Sci. Phila., 1892, 452.

Diptera—*Syrphidae*: (21) *Mesograpta marginata* Say, s. and f. p.; *Muscidae*: (22) *Lucilia cornicina* F., s.; *Anthomyidae*: (23) *Chortophila* sp., s., freq.

Lepidoptera—*Rhopalocera*: (24) *Pieris rapæ* L., s.

Coleoptera—*Malachidae*: (25) *Collops 4-maculatus* F., f.p.

	Halic- tus.	Other bees.	Other insects.	Total.
In the Pyrenees—MacLeod.....	—	1	—	1
In Low Germany—Müller.....	2	3	1	6
In Illinois.....	13	7	5	25

SIDA SPINOSA L.—“Nat. from the tropics.”—The stigmas receive pollen from the dehiscent anthers, but may be effectually dusted with pollen from other flowers in case of early insect visits. Later the styles bend and turn the stigmas in among the anthers, so that thorough self-pollination is insured. The plant has small yellow flowers. It was noted in bloom from July 25th to October 3d, and the following visitors were observed:—

Hymenoptera—*Apidae*: (1) *Bombus americanorum* F. ♂♂, s.; (2) *Ceratina dupla* Say ♀, s. and c. p.; *Andrenidae*: (3) *Augochlora pura* Say ♂, s.

Lepidoptera—*Papilionidae*: (4) *Pieris protodice* B.-L.; (5) *P. rapæ* L.; (6) *Colias philodice* Gdt.; (7) *Terias lisa* B.-L.; *Hesperidae*: (8) *Pyrgus tassellata* Scud.

ABUTILON AVICENNÆ Gärtn.—“Adv. from India.”—The flowers are yellow and occupy very inconspicuous positions under the large leaves. They are spontaneously self-pollinated in absence of insects, but may be cross-pollinated in their presence. For a long time I thought that nectar was wanting and that visitors never occurred, but in three days, August 21st to September 19th, I captured the following insects on the flowers:—

Hymenoptera—*Apidae*: (1) *Apis mellifica* L. ♀, s.; (2) *Bombus separatus* Cr. ♀, s.; (3) *B. americanorum* F. ♂♂, s.; (4) *Melissodes bimaculata* Lep. ♀, s. and c. p.; *Andrenidae*: (5) *Halictus confusus* Sm. ♀, c. p.; (6) *H. fasciatus* Nyl. ♀, s.; (7) *H. coriaceus* Sm. ♀, s.

Diptera—*Syrphidae*: (8) *Mesograpta marginata* Say, f. p.; *Anthomyidae*: (9) *Chortophila* sp., s.

Lepidoptera—*Papilionidae*: (10) *Pieris rapæ* L.; *Hesperidæ*: (11) *Pholisora catullus* F.

HIBISCUS LASIOCARPUS Cav.—With the exception of a single specimen of *Hibiscus militaris*, this is the only indigenous species of *Malvaceæ* which I have found in my neighborhood, and, as might have been expected, is the only one in which spontaneous self-pollination is impossible. It grows in swamps. The stalks, several of which form a cluster, rise from one to two metres, each stalk exposing two or three large flowers at a time.

The flowers are white or rose-tinted, with a crimson centre. They measure from eight to ten centimetres in length, and expand from nine to eleven centimetres, or more. The lower petals are directed horizontally; the upper are bent strongly upward like a vexillum, so as to be nearly perpendicular to the lower. The column lies near the lower petals and for about three centimetres from its base is provided with free filaments, which project upwards and sideways. On account of the flower being in an incipient stage of irregularity, the column still retains some useless filaments on the lower side, whose anthers seldom touch the bees. The five large capitate stigmas, which form a circle from nine to thirteen millimetres across, are advanced one or two centimetres before the nearest anthers, so that there is no chance of spontaneous self-pollination.

When visiting the flower, bees land upon the base of the column. The latter is bent upwards in such a position that the bees touch the stigmas before they alight. After sucking, the bees crawl out over the filaments and upon the lower petals and leave the flower without again touching the stigmas.

After alighting upon the column, *Emphor bombiformis*, which is the characteristic visitor, turns to the right or left and thrusts its proboscis into one nectary after another until it reaches the narrow interval between the column and the lower petals. Then it often turns back and inserts its proboscis into the nectary on the other side. Commonly, however, it fails to squeeze under the column to visit the nectary which lies there, and it often neglects to turn back for the nectary on the other side, and so leaves the flower without extracting the sweets from all the nectaries. Seventy-six individuals which I watched at this work missed eighty-one

nectaries in seventy-six flowers. On the other hand, *Bombus americanorum*, which is larger, more time-saving and less familiar with the flower, more frequently neglects to visit the nectary under the column and seldom turns back, so that it misses the lower nectaries even more frequently. I saw fifty-six individuals of this species miss eighty-five nectaries in fifty-six flowers. Both species also often miss the lower nectaries because, after inserting their proboscides into the upper ones and finding them empty, they arrive at the erroneous conclusion that the lower ones are in the same condition.

In their economy, the flowers of this plant and the bee first mentioned, *Emphor bombiformis*, stand in a very close relation. With the exception of single individuals taken on flowers of *Cephalanthus occidentalis* and *Ipomœa pandurata*, I have never taken this bee on any other flower. On the *Hibiscus* I have never failed to find it in favorable weather, and I have found the males in the closed flowers in bad weather. No specimens have been observed by me except during the blooming time of the plant, from July 25th to Sept. 16th. The female is provided with a large loose scopa which seems to be specially fitted to retain the large pollen grains, and this is the only flower on which I have seen it collecting pollen. Accordingly, I think the bee depends exclusively upon *Hibiscus* pollen for food for its larvae. I have seen the female making excavations for her nest within a few yards of the plants.

The only other insect at all frequent on the flower is *Bombus americanorum* F. ♂ ♀ ♂. I have never found this bee half as abundant, and commonly absent altogether, while the *Emphor* was abundant. This bumble-bee never collects the pollen. In addition to these insects I have seen the flowers visited for honey only by *Melissodes bimaculata* Lep. ♂ ♀ and by single individuals of *Bombus separatus* Cr. ♀, *Entechnia taurea* Say ♂, *Megachile brevis* Say ♂, *Euphoria sepulchralis* F. and *Trochilus colubris* L.

HIBISCUS TRIONUM L.³—"Adv. from Eur."—The five capitate stigmas stand close together, and pollen only touches the edges next to the dehiscent anthers. Most of the stigmas are thus free from pollen and can be effectually cross-pollinated in case of insect visits. After the flowers close, the styles bend outward and downward forcing the stigmas

³See Sprengel: Das entdeckte Geheimniss.

among the anthers so as to cover them with pollen. Thorough self-pollination is, therefore, only effected by a special movement of the stigmas, and only occurs after the flower has been exposed to insects. I have seen it visited only by a single individual of *Pieris rapæ* L.

GERANIUM CAROLINIANUM L.—The plant is common, blooming from May 23d to July 13th. The stem rises from 2 to 4^{dm}, is diffusely branched and bears numerous pale rose-colored flowers, which are not crowded so as to form an attractive combination.

The corolla is small, measuring about 7^{mm} across. In forms observed by me there are ten perfect stamens. The flowers are imperfectly proterandrous. The anthers of the inner circle are so closely approximated to the stigmas, that in absence of insects, spontaneous self-pollination may readily occur.

The flowers are adapted to small bees. June 10th I observed the following visitors:

Hymenoptera—*Apidæ*: (1) *Alcidamea producta* Cr. ♂♀, s., freq.; (2) *Osmia conjuncta* Cr. (=4-dentata Cr. ♂) ♀, s.; (3) *Calliopsis parvus* Rob. ♀, s. and c. p.; *Andrenidæ*: (4) *Agapostemon radiatus* Say ♀, s.; (5) *Augochlora pura* Say ♀, s. and c. p., freq.; (6) *Halictus pectoralis* Sm. ♀, s. and c. p., freq.; (7) *H. tegularis* Rob. ♀, s. and c. p.; (8) *H. stultus* Cr. ♀, c. p.; (9) *Prosopis affinis* Sm. ♀, s., freq.; *Eumenidæ*: (10) *Odynerus* sp., s., freq.

Diptera—*Syrphidæ*: (11) *Mesograpta marginata* Say, s., freq.; *Tachinidæ*: (12) *Hyalomyia purpurascens* Twms. s., one.

OXALIS VIOLACEA L.⁴—The scapes rise one decimetre, or more, high and expose an umbel of rose-purple flowers. The five petals expand 20^{mm}. At base they are approximated into a tube about 5^{mm} long, very wide in the throat, but obstructed by the ten stamens and five styles. The tube within is whitish, with greenish streaks proceeding from a greenish base. The calyx is about 4^{mm} long and is erect, aiding in giving firmness to the tube. In the long-styled form, spontaneous self-pollination is impossible, but in the short-styled form it may occur by the pollen falling upon the stigmas.

The plant is common and blooms from April 6th to June 10th. It is very abundantly visited by bees, mostly species

⁴See Trelease: The Heterogony of *Oxalis violacea*, Am. Nat. xvi; North American Geraniaceæ, Mem. Bost. Soc. Nat. Hist. iv; Trans. St. L. Acad. Science, v; Bot. Gaz. xii; Christy: Journ. of Bot. xxiii.

of small size. On eight days, between May 1st and 17th, I observed the following visitors:—

Hymenoptera—*Apidæ*: (1) *Apis mellifica* L. ♂, s.; (2) *Bombus americanorum* F. ♀, s.; (3) *B. pennsylvanicus* DeG. ♀, s.; (4) *Synhalonia speciosa* Cr. (= *Melissodes dilecta* Cr. ♂) ♂ ♀, s., freq.; (5) *Ceratina tejonensis* Cr. ♂, s., (6) *C. dupla* Say ♂ ♀, s., freq.; (7) *Osmia cognata* Cr. ♂, s.; (8) *O. albiventris* Cr. ♀, s. freq.; (9) *Nomada superba* Cr. ♀, s.; (10) *N. annulata* Sm. (= *articulata* Cr. nec Sm.) ♂, s.; (11) *N. sayi* Rob. ♂ ♀, s., freq.; (12) *N. cressonii* Rob. ♂; *Andrenidæ*: (13) *Andrena violæ* Rob. ♀, s.; (14) *A. ziziæ* Rob. ♂ ♀, s.; (15) *Agapostemon bicolor* Rob. ♀, s.; (16) *A. radiatus* Say ♀, s.; (17) *Augochlora pura* Say ♀, s., ab.; (18) *Halictus pectoralis* Sm. ♀, s.; (19) *H. forbesii* Rob. ♀, s.; (20) *H. lerouxii* Lep. ♀, s. and c. p., ab.; (21) *H. ligatus* Say ♀, s. and c. p.; (22) *H. fasciatus* Nyl. ♀, s. and c. p., ab.; (23) *H. pilosus* Sm. ♀, s. and c. p., ab.; (24) *H. confusus* Sm. ♀, s.; (25) *H. albipennis* Rob. ♀, s.

Lepidoptera—*Rhopalocera*: (26) *Phyciodes tharos* Dru.; (27) *Colias philodice* Gdt., (28) *Nisoniades brizo* B.-L.

MELILOTUS ALBA Lam.—“Adv. from Eur.”—The plant is common along side-walks. The stems rise from 6 to 12^{dm}, or more, in height and bear a profusion of spikes crowded with white blossoms. The flower measures about 4^{mm} in length to the tip of the keel. The calyx tube measures about 1^{mm} in depth, so that the nectar is easily accessible to short-tongued insects. The flower agrees in all essentials, except color, with that of *M. officinalis*, as described and figured by Müller in *Fertilization of Flowers*, 180. Müller saw *M. alba* visited by *Apis mellifica* L. ♀, *Macropis labiata* Pz. and *Empis livida* L.

The following were observed on June 23d and 25th:—

Hymenoptera—*Apidæ*: (1) *Apis mellifica* L. ♀, s., ab.; (2) *Bombus separatus* Cr. ♂, s.; (3) *Ceratina dupla* Say ♀, s. and c. p.; (4) *Megachile brevis* Say ♀, s. and c. p.; (5) *Alcidamea producta* Cr. ♀, s. and c. p.; (6) *Coelioxys 8-dentata* Say ♂ ♀, freq.; (7) *Epeolus fumipennis* Say ♂, s., freq.; (8) *Nomada incerta* Cr. ♀, s.; (9) *Calliopsis andreniformis* Sm. ♂ ♀, s. and c. p.; *Andrenidæ*: (10) *Macropis steironematis* Rob. ♂ ♀, s. freq.; (11) *Augochlora similis* Rob. ♂, s.; (12) *Halictus arcuatus* Rob. ♀, s. and c. p.; (13) *H. parallelus* Say ♀, s.; (14) *H. lerouxii* Lep. ♂ ♀, s. and c. p.; (15) *H. ligatus* Say ♀, s. and c. p.; (16) *H. fasciatus* Nyl. ♀, s.;

(17) *H. albipennis* Rob. ♀, s. and c. p.; (18) *H. confusus* Sm. ♂♀, s. and c. p., ab.; (19) *H. pruinus* Rob. ♂, s.; (20) *Sphecodes arvensis* Ptn. ♂, s.; (21) *Colletes eulophi* Rob. ♂♀, s.; (22) *C. willistonii* Rob. ♀, s.; *Vespidæ*: (23) *Polistes pallipes* Lep., s.; *Eumenidæ*: (24–26) *Odynerus* spp.; (27) *Odynerus fulvipes* Sauss.; (28) *O. arvensis* Sauss.; (29) *O. foraminatus* Sauss.; (30) *O. megæra* Lep.; *Crabronidæ*: (31) *Crabro interruptus* Lep., freq.; (32) *Oxybelus emarginatus* Say; *Philanthidæ*: (33) *Cerceris clypeata* Dlb.; *Sphæcidæ*: (34) *Ammophila gryphus* Sm.; (35) *A. vulgaris* Cr.; (36) *A. pictipennis* Walsh.; (37) *A. intercepta* Lep.; (38) *Isodontia philadelphica* Lep.; (39) *Sphex ichneumonea* L.; (40) *S. pennsylvanica* L.; (41) *Priononyx atrata* Lep.; *Pompilidæ*: (42) *Pompilus* sp.; (43) *P. relativus* Fox; (44) *P. navus* Cr.

Diptera—*Empidæ*: (45) *Empis* sp.; *Conopidæ*: (46) *Oncomyia loraria* Lw.; (47) *Conops brachyrrhynchus* Mcq.; *Syrphidæ*: (48) *Platychirus quadratus* Say; (49) *Syrphus americanus* Wd.; (50) *Allograpta obliqua* Say; (51) *Sphaerophoria cylindrica* Say; (52) *Syrirta pipiens* L.; *Tachinidæ*:⁶ (53) *Cistogaster occidua* Wlk.; (54) *Ocyptera euchenor* Wlk. freq.; (55) *Jurinia apicifera* Wlk.; (56) *J. smaragdina* Mcq.; (57) *Cuphocera ruficauda* v. d. W.; (58) *Micropalpus fulgens* Mg., ab.; (59) *Phorocera edwardsii* Will.; (60) *Acroglossa hesperidarum* Will., ab.; (61) *Trichophora echinomoides* Twns., ab.; (62) *Oliviera americana* Twns.; (63) *Pseudomyothyria nigricornis* Twns.; *Sarcophagidæ*: (64–65) *Sarcophaga* spp.; *Muscidæ*: (66) *Cyrtoneura* sp.; (67) *Lucilia caesar* L.; (68) *L. cornicina* F. —all s.

Lepidoptera—*Rhopalocera*: (69) *Chrysophanus thoe* B.-L.; (70) *Thecla humuli* Harr.; *Sesiidæ*: (71) *Sesia sexfasciata* Hy. Edw.

Coleoptera—*Scarabæidæ*: (72) *Trichius piger* F., s.; *Cerambycidæ*: (73) *Typocerus sinuatus* Newm., s.; *Mordellidæ*: (74) *Mordella marginata* Melsh., s.; *Curculionidæ*: (75) *Centrinus* sp.; (76) *C. picumnus* Hbst.; (77) *C. scutellum-album* Say, freq.

Hemiptera—*Lygaeidæ*: (78) *Lygaeus turcicus* F., s.; *Pen-tatomidæ*: (79) *Podisus spinosus* Dal., s., one.

Carlinville, Ills.

⁶The Tachinidæ mentioned in this paper were determined by Mr. C. H. Tyler Townsend.